

How to monitor and regulate Combined Sewer Overflows?

Comment mesurer et réguler les surverses de réseaux unitaires ?

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RÉSUMÉ

La directive européenne sur le traitement des eaux résiduaires urbaines (DERU) a récemment fait l'objet d'une évaluation approfondie. Comme les surverses des réseaux unitaires restent une préoccupation majeure pour la qualité des rivières européennes, la Commission Européenne en a proposé une révision incluant de nouvelles obligations légales pour la surveillance et le reporting des surverses. Dans plusieurs pays, il existe déjà des obligations de surveillance des surverses, mais ces données ne sont pas toutes publiques. Des exemples de données publiques sur les surverses existent à Bruxelles et au Royaume-Uni. Au Royaume-Uni, une base de données des bilans annuels des durées des surverses a été construite et rendue publique. Cette base de données a clairement montré des surverses massives à l'échelle nationale. Cela a généré une couverture médiatique considérable sur les surverses et permis des discussions plus informées sur la nocivité des déversoirs d'orage et la nécessité d'atténuer leurs déversements. Le projet Co-UDlabs, financé par l'UE, vise à encourager l'évaluation des systèmes d'assainissement urbain fondée sur les données. Il a commencé à examiner les pratiques en matière de collecte, de conservation et de publication des données sur les surverses en Europe. Les données disponibles seront analysées en détail afin d'évaluer leur utilité pour quantifier les impacts environnementaux. L'élaboration de réglementations sur les surverses et les décisions d'investissement pour leur réduction seront comparées entre différents pays, afin d'identifier les avantages et les inconvénients de l'utilisation de données librement accessibles sur les surverses.

ABSTRACT

Recently, the Urban Wastewater Treatment Directive (UWWTD) has undergone a thorough review. As Combined Sewer Overflows (CSOs) remain a major concern for European rivers quality, the EC has proposed a revision including new legal obligations for CSO monitoring and reporting. In several countries there is already requirements to monitor CSO spills, but not all of this data is openly reported. Examples of open CSO spill data are reported for Brussels and the UK. In the UK, a database of annual summaries of Event Duration Monitoring data from most CSOs has been built and made open to the public. This has clearly shown large amounts of emissions at a national scale. This has generated considerable press coverage about CSO emissions and enabled more informed discussions on the harm of storm overflows and the need to mitigate spills. The EU funded Co-UDlabs project aims to encourage data-supported assessment of urban drainage systems. The team are starting to examine data collection, curation and publication practices of CSO spill data throughout Europe. Available data will be analysed further to assess its utility to quantify environmental harm. Policy development of CSO regulations and investment decisions for mitigation actions will be compared between different countries, in order to identify the advantages and disadvantages of using openly available monitored CSO spill data.

1 KEYWORDS

Combined Sewer Overflows, Monitoring, Open data, Regulation, Water Quality

1 INTRODUCTION

Water quality in rivers Europe has improved since the introduction of the Urban Wastewater Treatment Directive (UWWTD). There are still concerns about untreated wastewater discharging through Combined Sewer Overflows. Pistocchi et al., (2019) and Gill et al., (2021) describe the need for improved monitoring and gathering evidence of potential harm caused by CSO spills. Whelan et al. (2022) stated that the majority of rivers in the UK does not reach a good ecological status, and this is often a consequence of multiple stressors, which need to be better identified and prioritised to enable continued recovery. They conclude targeted water quality monitoring is needed to better understand both drivers and potential impacts of pollution, to enable effective interventions. Rieckermann et al (2020) described how the biggest barriers towards more sustainable management of CSOs seem mainly related to policy and organizational adjustments. Manny et al. (2021) identified individual, organizational, and institutional barriers at the sub-national level that hinder the evaluation of data from sewer systems. Hence the question of how best to monitor and regulate combined sewer overflows remains open.

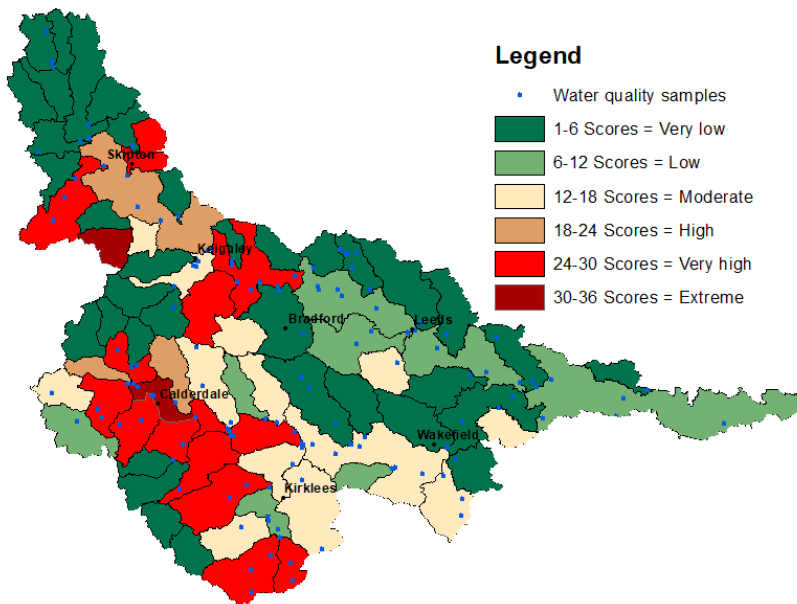
The current revision of the UWWTD requires establishing and implementation of integrated water management plans in all large agglomerations, where there is a risk for the environment (EU, 2022). New monitoring and “open data” obligations related to CSOs have also been proposed, (e.g. Article 17 - “Urban wastewater surveillance” and Article 21 – “Monitoring”), along with online information (article 24 – “Information to the public”).

In the UK, the requirement for CSO EDM monitoring started in 2013, after the relevant government Minister considered increased CSO monitoring “a real opportunity for the industry to show clear leadership, to be ambitious and to quantify these ambitions and share them with their customers, the Government and more widely”. Consequently, in 2021, an openly available database of annual summaries of Event Duration Monitoring (EDM) for most CSOs in England and Wales was made accessible (EA, 2022). This data has been used by the press and NGOs such as the River Trust (Rivers Trust, 2022) to reveal the spatial extent and size of CSO emissions. In 2021 around 372,000 spill events with a combined duration of 2,667,452 hours were recorded. This resulted in considerable press coverage and discussions on the harm of storm overflows leading to the government funding studies in CSO impact and mitigation. Gill et al. (2021), concluded that substantial investment is required to reduce harm from overflows, e.g., a policy limiting spills to 40 spills/year and 10 spills/year in sensitive locations would cost between £18 & £110 billion. Consequently the UK government developed a long-term Storm Overflow Reduction plan. In France, there are 3 legal criteria for CSO monitoring: i) no more than 20 days/year with overflows, or ii) less than 5 % of the annual wastewater volume discharged into the aquatic environment, or iii) less than 5 % of the annual wastewater pollutant loads discharged into the aquatic environment (JORF, 2015). Each operator must adopt one of these criteria over a 5 year period to demonstrate compliance. Depending on the dry weather BOD₅ load at a CSO, the requirements differ: i) measurement of daily duration of overflows and estimation of discharge in case the daily BOD₅ load is above 120 kg/day, and ii) continuous measurement of discharge and estimation of discharged pollutants loads (BOD₅, COD, TSS, NTK and P_{tot}) in case the daily BOD₅ load is above 600 kg/day and if there are overflows more than 10 days per year over a moving five year period. All operators must submit data to a national internet portal, annual reports about overflows to the local water police and water agency. However, the data are not public. Since these CSO monitoring requirements came into force in 1994, French water agencies encouraged and funded CSO monitoring instruments. Progressively, the focus moved to the data quality, (Meradou and Lefebvre, 2018), with improvements identified and mandated in new regulations. In Germany, Dittmer et al. (2015) investigated the data quality of a CSO monitoring database at a regional regulator. They found that, for 2013, less than 40% of the reported spill data passed a basic plausibility check. They suggest the approach for data collection given in the "Working Materials for Advanced Stormwater Treatment" (UM, 2007) as a good compromise between information content and survey effort. Also, they emphasize that “the collection of measurement data on the filling and spilling behaviour of CSOs is the only feasible way to monitor the success of combined sewerage treatment” and that data should be “collected on a larger scale and with appropriate care”. In Brussels, high quality data on rainfall, water levels in sewers, detention tanks and rivers, and water quality data is collected. These are publicly accessible on the FlowBru dedicated website (www.flowbru.be) since the beginning of the 2000s. These public data are widely used by the operator, researchers (e.g. de Ville and Verbanck, 2017), consulting companies, and citizens interested in i) flood risks (see the citizen participatory project FloodCitiSense: <http://www.floodcitisense.eu/>) or ii) CSO discharges. In the latter case, the CSO data from FlowBru and the resulting deteriorated water quality are used by citizens and NGOs (e.g. Canal It Up) to ask for sewer system improvements. The Canal It Up website includes data analysis, news, videos, and questions to decision makers and politicians about the need to decrease the detrimental effects of CSO spills on the Brussels canal.

It is clear that there is experience across Europe in both collecting various types of CSO spill data (quantity and quality) at both national and local levels and demonstrating that this type of data can have regulatory and public impact. These examples indicate the influence that publically available data can have and also the concerns about data uncertainty. The rest of the abstract will examine these issues and also how deeper analysis of such extensive data sets can lead to deeper insights of sewer networks and potentially more effective mitigation measures. This work has been carried out under the framework of the CoUDLabs project that is aiming to promote good data management practices in the field of urban drainage systems.

2 METHODOLOGY: UNLOCKING UNDERSTANDING

To tap the full potential of open CSO data, readily available and standardized tools for data visualization and exploration are required. In the UK, the impact of CSO EDM data was only unlocked with the interactive visualization by the River Trust NGO. Regarding the usability of open data, they should be FAIR (findable, accessible, interpretable and reusable). However, major challenges exist regarding the interpretability of urban drainage data, which require detailed specialist knowledge of the domain. For example, CSO spill data can provide a higher-level indication of where sewer systems are most overloaded, without detailed pipe network modelling. Annual storm overflow frequency and duration can be compared with spatial population density. The



UK Census data is openly accessible. It is spatially organised into Lower Layer Super Output Areas (LLSOA), which tend to be smaller than River Water Body Catchment (RWBC) areas. Most LLSOA's can thus be assigned to a RWBC area, and CSOs can mostly be assigned to LLSOAs (Norman, 2022). Hence an estimate can be made of the annual number of CSO spills per 10,000 inhabitants on a scale representing small towns, large villages or districts in cities. Alyahya, (2021) combined spill frequency and duration intervals per 10,000 inhabitants to obtain a severity score. Fig. 1 shows the scores for the RWBC areas and the locations of discrete surveillance water quality samples (blue dots).

Figure 1. CSO EDM severity scores in the Aire and Calder catchment, Alyahya, 2022

This indicates some urban areas show considerably more and longer duration CSO spills per 10,000 inhabitants than others. The general river surveillance water quality discrete sampling locations do not coincide with locations of maximum CSO severity. There could be various reasons for this mismatch: industrial decline leading to considerable part-abandoned paved areas for a population, and/or historical changes in design practice. In the UK, capacity has mainly been added through constructing storage tanks. Such design tends to be informed by river impact modelling studies and temporary year-long continuous water quality monitoring. In the last two decades, these studies tended to be commissioned 'reactively', this may have led to areas with higher population density and/or a population more capable of complaining, preferentially receiving CSO improvements.

3 CONCLUSIONS

Recent investigations highlight that it is not yet clear how best to regulate CSOs and target spending for river water quality improvements. The revised UWWTD has a new focus on monitoring CSOs. Further research is needed to ensure that funds spent on additional monitoring go towards activities that provide the most useful information on the drivers of poor water quality, so that in the long run informed analysis of CSO spill data leads to better targeted solutions. Nationwide collection of CSO spill data can help to objectively identify locations or sections of the public that have access to poorer performing drainage systems. Dealing with the impacts of CSO spills is a long term and multi-billion £/€ investment, analysis of national monitoring data can lead to substantial

optimisation of resources. The availability of open and comprehensive data, providing it is FAIR, can be used by the media and NGOs to effectively engage the public in policy development. This can lead to changes in legislation/regulations as demonstrated in the UK and EU. The Co-UDlabs project aims to promote good urban drainage data management, and also to show opportunities that analysis of large spatially distributed public data sets can bring, and how such datasets may impact on regulatory policy and water utility behaviour.

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